

Extended output voltage adjustment (0 V to 3.5 V) using the TI TPS5210

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This application note describes the design of a 12-V input/0-V to 1.3-V output synchronous buck regulator using the TI TPS5210 programmable controller. Although the output voltage can be extended down to 0 V to 1.3 V using the auxiliary circuitry described in this note, the supply will still be capable of providing an output voltage range from 1.3 V to 3.5 V, determined by the voltage identification code (VID).

The TPS5210, a synchronous buck regulator controller, provides an accurate, programmable supply voltage suitable for microprocessor power applications that require fast response to rapidly changing loads and precise voltage regulation.

A simplified diagram of the regulator circuit is shown in Figure 1. The diagram shows the 1% voltage reference, hysteresis control and gate drivers with adaptive dead-time control. The reference voltage ranging from 1.3 V to 3.5 V is determined by the VID. The hysteresis controller senses the output voltage through the feedback loop (V_{SENSE} pin) and the supply regulates the DC voltage level to the reference value (V_{REF}) set using the data on the VID pins. When the feedback voltage V_{SENSE} is rescaled to a specific value, the regulator output voltage can be extended to 0 V to 1.3 V.

Figure 2 shows the application circuit of the extended 1-V output, which is identical to the application shown in

Figure 1. Synchronous buck regulator using the TPS5210

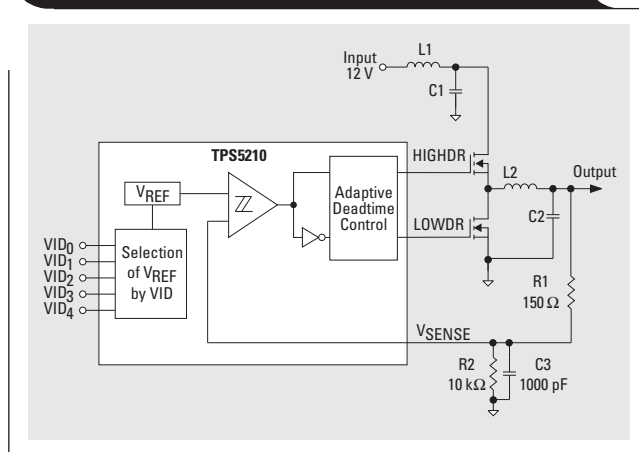
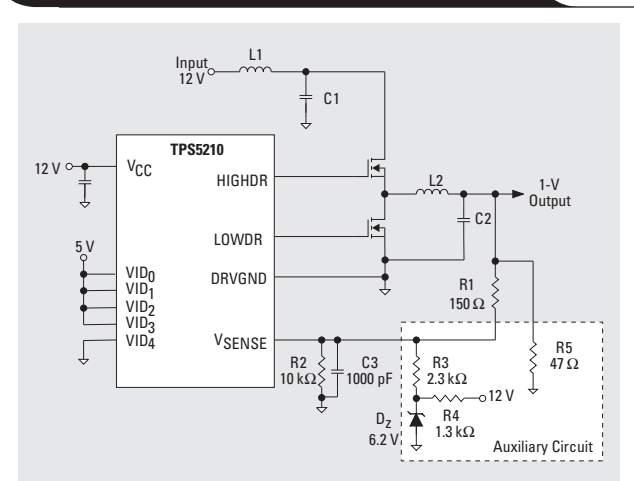


Figure 2. 1-V regulator using the TPS5210



Adding a few inexpensive components in the feedback path of TPS5210 enables the generation of 0-V to 1.3-V regulated.

Figure 1 (TPS5210 data sheet, literature number SLVS171A, Figure 18), except for the auxiliary circuit.

To operate the circuit for a 1-V output, the voltage reference (V_{REF}) should be set to 1.3 V using the VID code. The internal hysteresis comparator in the TPS5210 regulates the output voltage to 1.3 V, comparing V_{REF} (1.3 V) with the output feedback voltage, V_{SENSE} . Since the output voltage feedback signal (V_{SENSE}) is scaled to $1.3/1.0$ V (V_{SENSE}/V_{OUT}) by using a resistive voltage divider ($R1$ - $R3$) as shown in Figure 2, the output voltage is regulated at 1 V. The demand resistor ($R3$) value required for a 1-V output is calculated using Equation 1.

$$R3 = \frac{V_{DZ} - V_{SENSE}}{\frac{V_{SENSE} - V_{OUT}}{R1} + \frac{V_{SENSE}}{R2}} = \frac{6.2 - 1.3}{\frac{1.3 - 1.0}{150} + \frac{1.3}{10k}} = 2.3 \text{ k}\Omega \quad (1)$$

This method can also be applied to any output voltage ranging between 0 V to 1.3 V by using the above equation.

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C011905

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